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BEFORE THE
POSTAL RATE COMMISSION
WASHINGTON, D.C. 20268-0001

POSTAL RATE AND FEE CHANGES, 2000

Docket No. R2000-1

REBUTTAL TESTIMONY OF
DONALD M. BARON
ON BEHALF OF THE
UNITED STATES POSTAL SERVICE

CONTENTS

Page

PART 3

Part 4

Part 5

ATTACHMENT A

TABLES

TABLES

LIBRARY REFERENCES ASSOCIATED WITH THIS TESTIMONY

LR-I-453	Adjustment of Street-Time Percentages to Account for Differences in Distribution of Deliveries by Delivery Type Between the ES Sample and the Population of all City Carrier Letter Routes
LR-I-454	Changes in Street-Time Percentages Resulting from the Exclusion of Contested Load-Time Tallies

Autobiographical Sketch

My name is Donald M. Baron. I am currently a Vice President with Foster Associates, Inc., an economics consulting firm in Bethesda, MD. My education and experience are described in detail in my direct testimony, USPS-T-12.

Purpose and Scope of the Testimony

This testimony is divided into five parts. Part 1 reviews the methodologies that three witnesses - myself, Mark Ewen (OCA-T-5), and Antoinette Crowder (MPA-T-5) - have proposed for defining and measuring coverage-related load time on city carrier letter routes. In Mr. Ewen's Docket No. R2000-1 analysis, coverage-related load time includes stop time that is fixed with respect to the volume and mix of volume loaded at the stop. (Tr. 25/12063-64)). Ms. Crowder's Docket No. R2000-1 analysis presents a useful extension of this view by correctly defining stop-level load time as a nonlinear function of volume, and by deriving from that function a formula that defines coverage-load as strictly fixed stop time plus a very small, unmeasurable non-fixed component. (Tr. 32/16236--38).

Recognizing that coverage-related load time is therefore effectively defined as strictly fixed time at a stop, part 2 of this testimony determines how to measure fixed stop time. It examines two proposed measures - the residual of total load time over elemental load time, and my Docket No. R97-1 fixed-time estimate, defined as the average of the lowest load times recorded during the 1985 LTV Study at one-letter stops. This evaluation rejects the residual measure for several reasons. The residual isn't fixed with respect to volume; it is valid only if the stop-level load time model is linear, whereas the true load time model is highly nonlinear; and it produces measures of coverage-related load time that are much higher than operationally feasible.

Part 2 then examines my R97-1 methodology. This examination results in a proposed revised methodology for using 1985 LTV load times to directly estimate fixed stop time. Part 2 concludes by showing how this new measure effectively addresses the concerns raised by Mr. Ewen's review and my own evaluation of the previous fixed time measure.

Part 3 considers the alternative route-level load time analysis. It begins with a rejection of witness Crowder's argument that the ES-based route-level regression analysis presented in USPS-LR-I-310, I-386, and I-402 and my responses to UPS/USPS-T12-16 (a)–(b) and 20 (a)-(c) produces additional proof that the ES-based street-time percentages for load time are much too high. It also refutes Ms. Crowder's claim that the intercept terms derived from the route-level regression analyses imply fixed stop times that are nonsensical at the route level. Part 3 shows that Ms. Crowder misinterprets the route-level load time analysis and erroneously applies that analysis to the calculation of route-level fixed stop time. It shows further that Ms. Crowder is, in any event, incorrect in regarding estimates of positive route-level fixed stop time as constituting nonsensical predictions that carriers spend large amounts of time doing nothing.

Part 3 concludes with a review of the ES-based route-level regressions. It summarizes the favorable properties of the ES-based regression analysis, and the reasons this analysis should replace the stop-level analysis for calculation of volume-variable load time costs. Part 3 concludes that the regression presented in USPS-LR-I-402 and my response to UPS/USPS-T12-20 (a) - (c) is the best choice among the ES-based regressions I have evaluated.

Part 4 evaluates several issues relating to witness Crowder's critique of the new street-time percentages that I estimated in my Docket No. R2000-1 testimony based on data from the ES tally database produced by witness Lloyd Raymond. Part 4 rejects

Ms. Crowder's claim that the increase in load time between FY 1986 and FY 1998 implied by the new street-time percentages is operationally implausible. It demonstrates that when properly evaluated, the changes in load time per stop that occurred from 1986 to 1998 are realistic and consistent with significant changes in the carrier operating environment over this period. Part 4 also evaluates Ms. Crowder's allegation that certain tallies witness Raymond assigned to load time have location or activity codes that are inconsistent with the loading activity. I show that even if one accepts the validity of this allegation, it is immaterial, since the load time percentages fall very little when all such contested tallies are eliminated from the tally data set.

Part 4 does, however, agree with Ms. Crowder's judgment that the distribution of possible deliveries in the ES tally database across delivery-type categories is not representative of the corresponding distribution in the population of all city carrier letter routes. Part 4 therefore proposes an adjustment to the methodology for using the ES tally data to compute the street-time percentages. This new methodology explicitly accounts for the excessive percentage of residential curbline and centralized delivery points in the ES sample relative to the percentage in the population, and the relative deficiency of the ES sample's percentage of "residential other" delivery points.

Part 5 responds to witness Nelson's proposed new approach for calculating volume-variable loop/dismount driving time costs. I reject Mr. Nelson's proposal, and I recommend as an alternative that the volume variability of loop/dismount driving time be set equal to zero.

Part 1. Coverage-Related Load Time and Fixed Stop Time

The issue of how to define and measure coverage-related load time on city carrier letter routes generated considerable controversy in Docket No. R97-1. However, the Docket No. R2000-1 analyses presented by myself, witness Ewen, and witness Crowder have eliminated much of this conflict.

My R2000-1 testimony affirmed the view I expressed in Docket No. R97-1 that coverage-related load time is strictly fixed stop time, whereas elemental load time encompasses all time that varies in response to changes in volume at a stop. (USPS-T-12 at 7-9, 15-19). Thus, volume-variable coverage-related load time, in my view, captures the increase in fixed stop time that results when, due to volume growth, the carrier delivers mail to a new, previously uncovered stop.

In his responses to USPS/OCA-T5-12 (a) (1) and USPS/OCA-T5-2 (c), Mr. Ewen likewise acknowledges that coverage-related load time includes all stop time that is "fixed with respect to volume and volume mix at a stop, but [that] may vary across stops due to factors other than volume." (Tr. 25/12063-64). He agrees that elemental load is the portion of stop time that is dependent on mail volume at the stop (Tr. 25/12063-64)). Thus, Mr. Ewen agrees that the separate and distinct coverage-related activity – the activity that is **not** elemental load time – includes the activity that is fixed in length with respect to volume and volume mix.

Ms. Crowder also endorses this view. In response to USPS/MPA-T5-2(c), she states that fixed stop time is part of coverage-related load time. (Tr. 32/16239). She also defines fixed stop time as "the portion of time at [a] covered stop which does not vary with stop volume." (Tr. 32/16232).

This consensus reduces the remaining contentious issues to just two. The first is what, if anything, coverage-related load time encompasses beyond fixed stop time. The second is whether the residual or some version of my R97-1 fixed-time at stop estimate is the best measure of whatever final definition of coverage-related load time is correct.

In my view, Mr. Ewen has failed to enunciate what he believes coverage-related load time might include beyond fixed stop time, and that is not already captured by elemental load time. He also offers no analytical or empirical support to his endorsement of the residual measure, which calculates coverage-related load as the excess of total load time over elemental load time.

Ms. Crowder's Docket No. R2000-1 analysis is much more promising in this regard. Ms. Crowder shows through a new mathematical derivation that coverage-related load time equals fixed stop time plus a non-fixed component that accounts for variable load-time scale economies. However, my rebuttal demonstrates that this non-fixed component is necessarily a very small amount. Given this result, plus Ms. Crowder's failure to propose any methodology for applying available data and regression equations to quantify the non-fixed stop-time component, I conclude that, effectively, coverage-related load time equals just fixed stop time.

1.1 The Crowder Analysis Proves that Coverage-Related Load Time Equals Fixed Stop Time Plus a Non-Fixed Component

Ms. Crowder's R2000-1 analysis presents a new mathematical derivation of coverage-related load time that extends her Docket No. R97-1 analysis.[1] Thus, her new derivation builds onto a mathematical framework that the R97-1 PRC Decision accepted.[2]

Ms. Crowder first defines the following expression for total route-level load time:

$L = u * V + f * AS(V,PS)$ (1),

where u is a constant marginal load time with respect to route-level mail volume, V, f is fixed stop time, and AS is total route-level actual stops. Thus, $u = \partial L / \partial V$, and $f = \partial L / \partial AS$, and they are both constants. In particular, they are constant coefficients of the variables V and AS, respectively, which establishes the equation as linear in V and AS.

Acknowledging that variable load-time scale economies render this linearity assumption invalid, Ms. Crowder modifies equation (1) by redefining u as a function of volume (V) and actual stops (AS). The resulting new equation is:

$L(V,PS) = V * u\ [V, AS(V,PS)] + f * AS\ (V,PS)$ (2),

which now defines route-level load time as a nonlinear function of volume, as indicated by the fact that u now changes in response to changes in V and AS.

Attachment A shows that according to equation (1), coverage-related load equals the increase in load time that occurs when a mail piece goes to a new stop minus the increase in load time that occurs when that piece goes to an existing stop. The linearity

[1] R97-1, JP-NOI-1, Attachment B. The new approach is presented in Ms. Crowder's response to USPS/MPA-T5-2 (b). (Tr. 32/16236-38).

[2] Docket No. R97-1, Opinion and Recommended Decision, Volume 1 at 177-180.

of equation (1) implies that this excess load time at the new, previously uncovered stop is strictly fixed with respect to the volume and volume mix delivered at new stop. Furthermore, the residual measure, equal to total load time minus elemental load time, correctly measures this fixed time.

Because it accounts for the nonlinearity of the load time-volume relationship, equation (2) defines coverage-related load time differently than does equation (1). Equation (2), like equation (1) defines coverage-related load per stop as the additional stop time uniquely associated with delivering mail to a new, previously uncovered stop. However, unlike equation (1), equation (2) defines this additional stop time as fixed stop time **plus** a non-fixed component. Attachment A shows, specifically, that accrued route-level coverage-related load time in this case is $f * AS + (V * AS * \partial u / \partial AS)$, and volume-variable coverage-related load time is $[f * V + (V * \partial u / \partial AS) * V] * \partial AS / \partial V$. Accrued coverage-related load time per stop is thus, $f + (V * \partial u / \partial AS)$. Furthermore, $f * AS + (V * AS * \partial u / \partial AS)$ differs greatly from and thus invalidates the corresponding residual measure of coverage-related load time, $f * AS - (V * \partial u / \partial V) * V$, derived from equation (2).

Thus, Ms. Crowder's new mathematical derivation provides a critical validation of my Docket No. R2000-1 analysis showing that the residual measure of coverage-related load time is valid if and only if the load-time equation is linear. (USPS-T-12 at 12-16). Since my analysis also shows that the SDR, MDR, and BAM regressions are **highly** nonlinear equations, thus invalidating the residual as applied to these equations (USPS-T-12 at 16-18), my analysis also establishes that the nonlinear equation (2) is the more appropriate load time model.

A further evaluation of Ms. Crowder's new coverage-related load time per stop *expression,* $f + (V * \partial u / \partial AS)$, *derived from equation (2) is therefore required to* determine the operational significance of the non-fixed part of coverage-load. Since f is the fixed time portion, this non-fixed component is clearly $V * \partial u / \partial AS$. In this expression, $\partial u / \partial AS$ is the increase in total variable load time per piece that occurs when a new mail piece goes to a new, previously uncovered stop instead of to an existing stop. The reason this increase occurs is that, because of variable load-time scale economies, the additional variable load time generated at the new stop exceeds the additional variable load time generated at the existing stop. Non-fixed coverage-related load time per stop is this additional load time per piece, $\partial u / \partial AS$, multiplied by total route-level volume V. Thus, non-fixed coverage-related load time per stop equals the increase in total variable load time that occurs when a mail piece goes to a new stop *instead of to an existing stop. Route-level non-fixed coverage-related load time equals* this increase times total actual stops on the route

1.2 The Non-Fixed Component of Coverage-Related Load Time is Extremely Small Because it Accounts for the Increase in Total Variable Load Time Per Piece of Delivering Mail to Just One New Stop

However, a closer examination of $V * \partial u / \partial AS$ also establishes that this non-fixed coverage-related load time per stop is an extremely small time increment. The reason is that $\partial u / \partial AS$, the increase in total variable load time per piece that occurs when mail goes to a new stop instead of an existing stop, is very small. A simple but realistic example shows why. Suppose that, prior to the one-piece volume increase, 2,460 mail pieces are delivered across 490 actual stops on the route, producing a total route-level variable load time of 4,466.13 seconds, and a unit variable load time of

1.815500 seconds per piece. Suppose further that the loading of the additional mail piece at the new, previously uncovered stop adds 2 seconds of variable load time. This amount is higher than the 1.815500 seconds per piece at the original 490 stops due to the loss of scale economies resulting from delivery of the piece to a previously uncovered stop. This variable load time of 2 seconds will increase total variable load time to 4,468.13 seconds and variable load time per piece to (4,468.13/2,461), or 1.815575 seconds. Thus, it will increase variable load time per piece by only 1.815575 minus 1.815500, or 0.000075 seconds. The corresponding increase in total variable load time will be only 0.000075 seconds * 2,461 pieces, or about 0.1844 seconds. Moreover, this 0.1844-second increase is the non-fixed portion of total coverage-related load time per stop.

The reason this amount is so small is obvious. Total variable load time at the original 490 stops and corresponding total variable load time remain absolutely constant when the one new mail piece goes to the one additional actual stop. This constancy of variable load time per piece at all but one of the new total of 491 actual stops virtually nullifies the positive effect on variable load time per piece of the additional variable load time generated at just the one new stop.

This extremely small magnitude of the non-fixed coverage-related load time measure derived from equation (2) is one reason coverage-related load should be regarded as strictly fixed stop time. Another reason is that the functional form of equation (2) unrealistically defines load time as a function of only one volume term. It does not, therefore, accurately represent the real world definition of load time, presented in the SDR, MDR, and BAM regressions, as being a function of five separate volume terms. For this reason, Ms. Crowder is unable to show how she would use these three regressions to derive corresponding real world estimates of the $V * \partial u / \partial AS$ non-fixed coverage load formula.

Thus, although this non-fixed coverage load formula is an interesting theoretical concept, and although it presents a challenging measurement problem, Ms. Crowder offers no approach to compute such a measurement. On the other hand, her failure does not present a serious impediment, given that the magnitude of non-fixed coverage-related load time must be inconsequential. The best practice, therefore, is to assume, for computational purposes, that it is not significantly different from zero, and that therefore coverage-related load time is, indeed, fixed stop time only.

Part 2. A Revised Direct Estimation of Fixed Stop Time is Superior to the Residual Measure

This decision leaves as the remaining issue that of which methodology should be used to estimate the fixed time component of coverage load. As observed earlier, two alternatives are available. One is my Docket No. R97-1 methodology, which estimates fixed stop time as the average of the bottom quintile of load times measured in the 1985 study at stops receiving one letter piece. (USPS-T-17 at 9-12). The second is the residual measure, endorsed by witness Ewen (Tr. 25/12027-28, 12043). It equals the excess of accrued load time over elemental load time, where elemental load time equals accrued time multiplied by the aggregate of the stop level load time elasticities with respect to volumes (as derived from the SDR, MDR, and BAM regressions).

2.1 The Residual Measure Fails for Several Reasons

The residual measure is unacceptable for several reasons. First, as I showed in my Docket No. R97-1 analysis, the residual violates the premise of the fixed-time at stop definition. (USPS-T-17 at 34-36, UPS/USPS-T17-14 (b)–(d)). It is **not** fixed with respect to mail volume or volume mix delivered at a stop.

Second, as both Ms. Crowder's Docket No. R2000-1 interrogatory responses and my Docket No. R97-1 rebuttal testimony have demonstrated, the residual is the correct measure of coverage-related load time only if the load time equation defines load time as a strictly linear function of volume.[3] (Tr. 33/16236-38, Docket No. R97-1, USPS-RT-1 at 17-22). Specifically, when the load time equation is linear, coverage-related load time is strictly fixed stop time and is correctly measured by the residual. My R2000-1 Testimony further shows that the available stop-level load time regressions – the SDR, MDR, and BAM regressions – are highly nonlinear, thus invalidating the residual formula. (USPS-T-12 at 16-18). This finding is confirmed by Ms. Crowder's derivation from the nonlinear route-level equation of a correct formula for coverage-related load that is much different than the route-level residual measure.

Given this mathematical proof that the residual is invalid when the load time equation is nonlinear, and the strong evidence that the existing stop-level regressions are highly nonlinear, it is not surprising that BY 1998 estimates of the residual provide grossly unrealistic predications of fixed stop time. These poor predictions constitute probably the most compelling reason to reject the residual. According to the residual formula, BY 1998 coverage-related load time per stop equaled 6.65 seconds per SDR stop, 17.35 seconds per BAM stop, and 39.90 seconds per MDR stop.[4] These estimates are much too high to qualify as realistic predictions of fixed stop time. The BAM and MDR results are particularly nonsensical. Clearly, no plausible operational

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[3] See also Attachment A to this testimony.
[4] Derived from USPS-LR-I-80, Cs06&7.xls, Worksheet 7.0.4.2.

theory exists that can justify a view that a carrier spends an average of nearly 40 seconds at each MDR stop conducting activities that are fixed in length with respect to the volume delivered. Moreover, the very wide discrepancies among these three residual-based estimates of fixed stop time are equally far-fetched. Again there is no rational operational basis for such large differences. Thus, it is not surprising that, despite his endorsement of the residual measure, Mr. Ewen was unable to provide any operational explanation as to why, for example, the BY 1998 BAM residual time per stop is 2.61 times larger than the corresponding SDR value. Mr. Ewen could only guess, without substantiation, that this 161% excess of the BAM measure over the SDR measure might not be statistically significant.[5] (Tr. 25/12080).

2.2 The Best Measure of Fixed Stop Time is a Revised Direct Estimate that Accounts for Variations in Fixed Stop Time in Response to Non-Volume Stop Characteristics

With the residual discredited as a measure of fixed stop time, the remaining measure to evaluate is my own formula based on 1985 load times recorded at one-letter stops. The rationale for this formula is straightforward. Fixed time at a stop should be no more than the minimum total load time expended in the delivery of one letter piece to that stop. Thus, a common sense estimate of fixed stop time would equal the minimum of the observed load times over all one-letter stops.

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[5] Mr. Ewen did state that accrued load time per stop is higher and elemental load time elasticity lower for BAM stops than for SDR stops. However, this statement describes only the mechanics of the residual formula that produce the higher coverage-related load time for BAM stops. It does not explain, operationally, **why** the excess of residual coverage-related load time per BAM stop over corresponding residual load time per SDR stop is so large, especially given Mr. Ewen's own concept of coverage-related load time. Mr. Ewen regards coverage-related load time as fixed time per stop plus some undefined additional component or components. (See Mr. Ewen's responses to USPS/OCA-T5-12 (a) (1), 15 (a)-(c)). Certainly, the 10.7 seconds by which residual coverage-related load time per BAM stop exceeds residual coverage-related load time per SDR stop cannot realistically be regarded as fixed stop time only. This fact, plus Mr. Ewen's failure to identify what the non-fixed component might be, or to describe in what operational sense it differs from the other load time components leaves Mr. Ewen with no explanation at all as to what is taking place during this additional 10.7 seconds.

Consider, for example, one-letter SDR stops. 1,373 tests in the 1985 LTV Study (out of a grand total of 16,037 SDR tests) recorded load time for carriers delivering to these stops. Of these 1,373 tests, the lowest recorded load time was 0.4 seconds. It is logical to conclude that if the **total** load time required for a carrier to deliver a letter is 0.4 seconds, the fixed stop time, which is only part of the total load time, can be no greater than 0.4 seconds. (Docket No. R97-1, USPS-T-17 at 9-11).[6]

However, load times observed in the 1985 Study at all one-letter stops across all three stop types varied substantially. For example, load times at one-letter SDR stops varied from a low of 0.4 seconds up to a high of 6.34 seconds. This wide variation impugns the accuracy of just the lowest observed value as an estimate of fixed time at all stops of the given stop type throughout the entire system of routes. The SDR results again provide a good illustration of this concern. The 0.4 seconds minimum observed SDR load time was observed at only 5 out of the 1,373 SDR tests conducted at one-letter stops. The wide variation among all 1,373 load times suggests that an estimate based on just 5 observations is highly suspect. This problem is even worse at MDR and BAM stops. The minimum observed BAM and MDR load time of 0.5 seconds was observed at only 2 out of the 80 LTV tests conducted at one-letter BAM stops, and at only 1 out of the 49 tests conducted at one-letter MDR stops.

To ensure greater accuracy, I therefore decided that instead of choosing just the lowest observed load times among those measured at one-letter stops, I would derive my estimate of fixed stop time for each stop type from the bottom quintile of observed one-letter load times for that stop type. I calculated each such estimate as the simple

[6] See Docket No. R87-1, Exhibit USPS-8-C, USPS LR-E-38, and USPS LR-G-140 for descriptions and analyses of the 1985 field survey and survey data set.

average of all observed load times in this bottom quintile. The results are estimated *average fixed times per stop of 1.052, 1.110, and 0.919 seconds, respectively, for the* SDR, MDR, and BAM stops.

A remaining problem with this approach is the arbitrariness of choosing the bottom quintile of one-letter load times observed in the 1985 Study as the source of the data that I averaged to compute these fixed stop times. There is no statistical basis for choosing this quintile threshold instead of some other threshold, such as the bottom decile, or bottom quartile of tests. Moreover, in securing enough observations of one-letter load times to compute average times per stop that I believed were sufficiently reliable, the values I obtained included numerous load times that were actually higher than load times recorded at stops that received two or more mail pieces.

A second problem with my Docket No. R97-1 approach is that the method of averaging the bottom quintile of load times measured at one-letter stops does not explicitly account for the variation in fixed stop time that occurs across stops in response to variations in non-volume stop characteristics. As Mr. Ewen has argued - and I find this argument persuasive - fixed stop time, by definition, is fixed only with respect to volume and volume mix. (Tr. 25/12063-64). Thus, fixed stop times at two stops having the exact same volume and volume mix can still vary as a result of differences in the types of container used by the carrier and the types of receptacles he puts mail into.

However, Ms. Ewen incorrectly contends that because the R97-1 fixed stop time estimates do not incorporate these non-volume stop effects, the appropriate response is to simply abandon the direct estimation approach entirely and adopt the residual measure. (Tr. 25/12042-43). He thereby ignores the serious deficiencies of that measure, as described earlier. He also ignores the obvious, more common sense response of simply modifying the direct estimation procedure so that it will incorporate the non-volume effects.

I therefore propose such a modification myself. To directly account for the variation in fixed stop time caused by variations in receptacle and container type, I have changed the averaging procedure applied in the direct estimation. For each stop type, my new approach first identifies each combination of a receptacle type and a container type that had at least one 1985 LTV stop where only one letter was loaded. For each such combination, I then select the single lowest load time measured across all one-letter stops. Each such minimum observed load time is then multiplied by a weight equal to the percentage of all one-letter load time tests that fall within the given receptacle-container type category. The estimated fixed time per stop is then defined as the sum of all such weighted minimum observed load times.

Consider the application of this methodology to MDR stops. Of the 49 load times recorded in the 1985 Study at one-letter MDR stops, 24 or 49.0% were recorded at stops having mail box receptacles with a container type of "loose mail." Thus, the lowest recorded load time at these stops, 0.5 seconds, is multiplied by a weight of 0.49. Similarly, only 1 test, or 2.0% of the total, was conducted at a stop having a mail box with a container type of "sack or pouch." The load time at this stop, 3.5 seconds, is therefore multiplied by a weight of 0.02. Table 1 below shows corresponding weights, minimum recorded load times, and products of weights times minimum load times for these categories plus all the other receptacle-container type categories that had at least one single letter MDR stop. The sum of all such products – that is, the sum of all the weighted minimum observed load times – equals an estimated weighted average fixed time per MDR stop of 1.568 seconds.

Table 1. Fixed Stop Time at MDR Stops Estimated as the Weighted Average of Minimum Observed Load Times Recorded During the 1985 LTV Study at One-Letter MDR Stops

Receptacle-Container Type	Minimum Observed Load Time At One-Letter Stops	Total Number of Tests at One-Letter Stops in this Category	Number of One-Letter Tests as a Percentage of Total One-Letter Tests	Weighted Minimum Observed Load Time
Mail Box – Loose Mail	0.5	24	49.0%	0.245
Mail Box – Sack or Pouch	3.5	1	2.0%	0.071
Curbline Box-Loose Mail	7.3	2	4.1%	0.298
Multi-Apartment Boxes-Loose Mail	4.8	6	12.2%	0.588
Rural-Type Box-Loose Mail	1.0	4	8.2%	0.082
Handed to Customer-Loose Mail	1.8	1	2.1%	0.037
Other-Loose Mail	1.1	11	22.4%	0.247
Total – All Types			100.0%	1.568

Tables 2 and 3 present corresponding weighted average estimates of fixed time per stop for SDR and BAM stops. Again, each weight is equal to the percentage of total one-letter load time tests conducted in the 1985 LTV Study at stops located within the given receptacle-container type category.

Table 2. Fixed Stop Time at SDR Stops Estimated as the Weighted Average of Minimum Observed Load Times Recorded During the 1985 LTV Study at One-Letter SDR Stops

Receptacle-Container Type	Minimum Observed Load Time At One-Letter Stops	Total Number of Tests at One-Letter Stops in this Category	Number of One-Letter Tests as a Percentage of Total One-Letter Tests	Weighted Minimum Observed Load Time
Door Slot – Loose Mail	0.6	131	9.5%	0.057
Door Slot – Bundled Mail	0.7	10	0.7%	0.005
Door Slot – Tray	2.8	3	0.2%	0.006
Door Slot – Sack or Pouch	2.4	13	0.9%	0.023
Mail Box – Loose Mail	0.4	606	44.1%	0.176
Mail Box - Bundled Mail	0.4	6	0.4%	0.002
Mail Box – Sack or Pouch	1.2	36	2.6%	0.031
Curbline Box- Loose Mail	0.4	199	14.5%	0.058
Curbline Box – Tray	1.3	28	2.0%	0.026
Desk Drop – Loose Mail	1.1	5	0.3%	0.004
NDCBU – Loose Mail	20.7	2	0.1%	0.030
Rural-Type Box- Loose Mail	0.4	48	3.5%	0.014
Handed to Customer- Loose Mail	0.7	15	1.1%	0.008
Handed to Customer – Bundled Mail	20.8	1	0.1%	0.015
Placed Under Door – Loose Mail	5.8	1	0.1%	0.004

Table 2. Fixed Stop Time at SDR Stops Estimated as the Weighted Average of Minimum Observed Load Times Recorded During the 1985 LTV Study at One-Letter SDR Stops				
Receptacle-Container Type	Minimum Observed Load Time At One-Letter Stops	Total Number of Tests at One-Letter Stops in this Category	Number of One-Letter Tests as a Percentage of Total One-Letter Tests	Weighted Minimum Observed Load Time
Placed Under Door – Bundled Mail	2.7	1	0.1%	0.002
Other – Loose Mail	0.9	245	17.8%	0.160
Other – Bundled Mail	0.6	25	1.8%	0.011
Total – All Types			100.0%	0.633

Table 3. Fixed Stop Time at BAM Stops Estimated as the Weighted Average of Minimum Observed Load Times Recorded During the 1985 LTV Study at One-Letter BAM Stops				
Receptacle-Container Type	Minimum Observed Load Time At One-Letter Stops	Total Number of Tests at One-Letter Stops in this Category	Number of One-Letter Tests as a Percentage of Total One-Letter Tests	Weighted Minimum Observed Load Time
Door Slot – Loose Mail	1.5	2	2.5%	0.038
Mail Box – Loose Mail	1.0	6	7.5%	0.075
Mail Box – Bundled Mail	4.4	1	1.25%	0.055
Curbline Box-Loose Mail	2.1	8	10.0%	0.210
Curbline Box – Tray	1.9	1	1.25%	0.024
Desk Drop – Loose Mail	0.5	28	35.0%	0.175
Desk Drop – Sack or Pouch	6.8	2	2.5%	0.170

Table 3. Fixed Stop Time at BAM Stops Estimated as the Weighted Average of Minimum Observed Load Times Recorded During the 1985 LTV Study at One-Letter BAM Stops				
Receptacle-Container Type	Minimum Observed Load Time At One-Letter Stops	Total Number of Tests at One-Letter Stops in this Category	Number of One-Letter Tests as a Percentage of Total One-Letter Tests	Weighted Minimum Observed Load Time
Rural-Type Box-Loose Mail	11.1	1	1.25%	0.139
Handed to Customer-Loose Mail	0.5	10	12.5%	0.0625
Handed to Customer – Sack or Pouch	1.8	1	1.25%	0.0225
Placed Under Door – Loose Mail	5.7	1	1.25%	0.071
Other – Loose Mail	0.7	19	23.75%	0.166
Total – All Types			100.0%	1.2075

The new approach just described is more reliable than my R97-1 methodology for estimating fixed stop times for two reasons. First, it does not require the statistically unsupportable, arbitrary selection of the bottom quintile of load times observed at one-letter stops as a means of obtaining multiple observations of such load times on which to base a fixed time estimate. Instead, it obtains the single minimum observed load time recorded for each of several different receptacle - container type categories. Second, this new approach not only, in this manner, creates a sample of at least 7 observations for computing an average fixed stop time. It also allows for the construction of an average time that explicitly accounts for the way in which fixed stop times vary with changes in non-volume stop characteristics. Thus, for example, the new measure of 1.57 seconds for fixed MDR stop time is improved relative to the old measure (1.11 seconds) because it accounts for the relatively higher minimum load times observed at MDR stops containing multiple-apartment box receptacles or curbline box receptacles and the fact that over 14% of all one-letter MDR load time tests were conducted at such stops.

I therefore propose that this 1.57 seconds for MDR stops, along with corresponding estimates of 0.63 seconds for SDR stops and 1.21 seconds for BAM stops should be regarded as the best currently available measures of coverage-related load time per stop that can be derived from existing stop level data. Furthermore, I propose to substitute these new weighted average fixed stop times for the previous measures (1.052 seconds for SDR, 1.110 seconds for MDR, and 0.919 for BAM) that the Postal Service has applied in its BY 1998 load time cost analysis. In doing so, I acknowledge that these new fixed stop time estimates are still not entirely satisfactory. They are still based on a relatively few observations from the 1985 LTV test. Moreover, the receptacle/container type weights used to compute the weighted fixed time averages are based on 1985 percentages of stops across receptacle and container categories. The likelihood that these percentages are not as accurate as we would prefer as estimates of percentage allocations relevant to the BY 1998 analysis suggests that the use of 1985 percentages as weights may further reduce the accuracy of the fixed stop time estimates.

Nevertheless, these new fixed stop times are unquestionably superior to the residual-based estimates supported by Mr. Ewen. Given that coverage-related load time is fixed stop time – except for an inconsequential, unmeasurable non-fixed component - the BY 1998 residual-based estimates of coverage-related load time per stop are meaningless. Ranging from 6.65 seconds per stop for SDR stops to 17.35 seconds per stop for BAM and 39.90 seconds per stop for MDR stops, these residual-based estimates are much too high to qualify as plausible measures of fixed stop time. The inexplicable, extremely large discrepancies among these three measures constitute further proof of their detachment from operational reality.

In contrast, the new weighted-average estimates of fixed stop time derived from the 1985 LTV load times are operationally plausible. They are within the range of expected stop times generated by carriers conducting the types of activities – such as pre-loading functions and opening and closing receptacles – that require time that is fixed with respect to the amount of volume delivered, but that may vary with respect to non-volume stop characteristics. Finally, the analyst who believes the fixed stop time activity is too poorly defined to justify concluding that fixed stop time does exists has no choice but to conclude that coverage-related load time also does not exist, for coverage-related load time is fixed stop time. My view is that coverage-related load time does exist, and the new weighted-average of the minimum observed 1985 LTV load times is its best possible measure.

2.3 Summary of the Stop-Level Load-Time Analysis

This recommendation to use the weighted-average estimates of fixed stop time to measure coverage-related load time per stop completes my proposed stop-level load time analysis. Aside from the substitution of these new estimates for my previous fixed-stop time estimates, this proposed approach is the same as the approach I presented in my Docket No. R97-1 testimonies, and reaffirmed in my Docket No. R2000-1 direct testimony. Specifically, I recommend that the Postal Service continue to use the (now revised) fixed stop time estimates to derive corresponding aggregate annual fixed-time at stop costs for the three stop types, as it does in worksheet 7.0.4.2 of USPS-LR-I-80, workbook Cs06&7.xls. These costs should be deducted from the initial aggregate annual accrued load time costs derived from the street time percentages for carrier loading. Furthermore, Cs06&7.xls should continue to split these fixed-time costs into volume-variable and institutional costs, and to distribute the volume-variable costs across mail subclasses, in the exact same manner that it allocates accrued access costs to products. Cs06&7.xls should also continue to multiply the elasticities of load time derived from the SDR, MDR, and BAM regressions with respect to letters, flats, parcels, accountables, and collections by the remaining non-fixed time loading costs to derive elemental load time costs for each volume term.

Part 3. The Route-Level Load-Time Variabilities

This proposed stop-level cost analysis presupposes of course a decision to continue to apply the stop-level SDR, MDR, and BAM regression equations to compute volume-variable load time costs. This supposition is critical, because I have, in fact, strongly recommended against such a decision. As I argue in response to Docket No. R2000-1, UPS/USPS-T12-16, I believe that the new ES-based route-level load time regression analysis quantifies the current load time-volume relationship much more accurately, and produces much more reliable volume variabilities than do the SDR, MDR, and BAM regressions.

In the remainder of this section of my testimony, I therefore respond to arguments by witness Crowder that relate to whether this new ES-based regression should be substituted for the stop-level regressions, as I strongly recommend, and to using this new regression to derive volume-variable load time costs. First, I challenge Ms. Crowder's claim that the ES-based regression analysis produces additional evidence proving that the street time percentages derived for the loading activity are much too high.[7] Second, I show that even if one endorses, arguendo, this erroneous allegation, the ES-based regression analysis still provides the correct basis for deriving volume-variable costs. I next analyze comments made by Ms. Crowder that support the application of the ES-based regression analysis in the event the new street-time percentages derived from the ES tally dataset are used to allocate accrued letter-route street time costs across activity categories. My analysis also rejects Ms. Crowder's interpretation of the deliveries variable in the ES-based regressions. Finally, I review my responses to Docket No. R2000-1, UPS/USPS-T12-20. This review demonstrates why the latest ES-based regression produced in these responses, and presented in USPS-LR-I-402, is superior to the previously recommended version presented in USPS-LR-I-386, and that this latest version should be used to derive BY 1998 volume-variable load time costs.

3.1 Ms. Crowder's Argument that the ES-based Regression Analysis Proves that Street Time Percentages for Loading are too High Should be Rejected

Ms. Crowder's allegation that the ES-based route-level regression analysis reveals how the estimated percentages of total street time devoted to carrier loading are too high is derived from her evaluation of the weighted average intercept in this regression. (Tr. 32/16189-91, 16203-06). Ms. Crowder's evaluation applies specifically

[7] USPS-LR-I-159 derived these percentages from the ES tally data set prepared by witness Raymond in USPS-LR-I-163. Mr. Raymond subsequently submitted USPS-LR-I-383, which contains a slightly revised version of this data set.

to the regression presented in USPS-LR-I-310, but, if valid, it would apply equally to what I believe is the more accurate ES-based regression. This regression, summarized in tables 3D and 4D of my response to UPS/USPS-T12-20 (c), defines small parcels and rolls (SPRs) as a separate right-hand side variable, instead of combining it with flats or with parcels, as had been done in the USPS-LR-I-310 and USPS-LR-I-386 regressions. Therefore, I will present Ms. Crowder's analysis as applied to the Table 3D - 4D regression.

Ms. Crowder's argument relates to the combination of right-hand side variable coefficients that she regards as the weighted-average intercept term. The relevant coefficients are the intercept itself plus the coefficients for the seven fractions of total possible deliveries located within the corresponding seven delivery-type categories. These coefficients are reproduced below from Table 3D of my UPS/USPS-T12-20(c) response.

Independent Variable	Coefficient Estimate
Intercept	-4,885.84
% of Deliveries That Are Residential Other	5,768.49 (25.33%)
% of Deliveries That Are Residential Curb	8,657.60 (40.49%)
% of Deliveries That Are Residential Central	7,518.82 (12.20%)
% of Deliveries That Are Residential NDCBU	7,140.73 (12.42%)
% of Deliveries That Are Business Other	4,260.11 (5.6%)
% of Deliveries That Are Business Curb	2,091.71 (1.2%)
% of Deliveries That Are Business Central	10,101.00 (1.3%)

Ms. Crowder argues that for any normal load time route-day, the weighted-average intercept equals the negative intercept value plus the weighted average of the seven percent of possible delivery coefficients. The weight for each delivery type equals its average percentage of total possible deliveries over all 750 route-days in the

ES regression data set.[8] (Tr. 32/16203-06). For example, the weight for the Residential Other category, 25.33%, is the average of the 750 residential other percentages of total possible deliveries. In the above table, all seven of these delivery type percentages are listed in parentheses next to the corresponding regression coefficients. To calculate the weighted average, Ms. Crowder's methodology multiplies each of these seven percentages by its corresponding regression coefficient, and then adds the resulting seven products. The sum of this weighted average plus the intercept coefficient of –4,885.84 equals an overall weighted average intercept of 2,278.92 seconds.

Ms. Crowder's analysis interprets this result as establishing that for a normal (non-high load time) route day, the ES-based load time regression summarized in Table 3D of my response to UPS/USPS-T12-20(c) predicts a load time of 2,278.92 seconds at zero volumes loaded. Furthermore, this ES-based load time regression is actually predicting, according to the Crowder interpretation, that 2,278.92 seconds of total daily load time will be generated on a zero-volume day. Since it is obviously absurd that any such large positive load time should occur when nothing is delivered, the Crowder interpretation views this prediction of 2,278.92 seconds as proof that there is a serious flaw in the regression analysis. This alleged flaw is the presence of large amounts of time recorded for the load time variable that is really access times, not load time. In other words, the prediction of 2,278.92 seconds at zero volumes proves, according to the Crowder argument, that the load times per route day in the ES regression data set are much too high. These excessive load times also establish, according to this

[8] See USPS-LR-I-402.

argument, that the load time percentages of total street time that produced these estimated load times are also much too high. (Tr. 32/16203-06).

I reject this interpretation of the route-level regression analysis for two reasons. First, Ms. Crowder is incorrect in concluding that the sum of the negative intercept term and the weighted average of the estimated coefficients of the delivery-type percentage variables predicts total daily route-level load time at zero volumes. In deriving this inference, Ms. Crowder forgets that the regression coefficients for right-hand side variables in a regression are accurately applied only to variable values falling within the range of data used to estimate those coefficients.[9] Ms. Crowder's analysis commits the error of applying regression coefficients to variable values well outside this range because, even at the low end of the route-level volumes, the sum of the right-hand side volumes – letters, flats, SPRs, parcels, and accountables – is much higher than zero (equaling 202 letter pieces per day). The estimated weighted intercept value derived by Ms. Crowder at a total volume of zero pieces per route day is thus a highly unreliable prediction derived at values to which the regression coefficients do not realistically apply.[10]

Second, even if, for the sake of argument, this weighted intercept , 2,278.92 seconds, is regarded as a reasonably accurate measure of total fixed stop time over the entire route, Ms. Crowder's interpretation of this predicted time is erroneous. This interpretation views the 2,278.92 seconds as a forecast that the carrier will spend

[9] See Douglas C. Montgomery and Elizabeth A. Peck, Introduction to Linear Regression Analysis, John Wiley & Sons, 1982, at 39-41, 142-143.

[10] Ms. Crowder repeats this error in evaluating her own regression of route-level load time on delivery mode and deliveries by delivery type. (Tr. 32/16196-202). She again erroneously views the weighted-intercept derived from this regression as a reliable prediction of significant fixed route-level stop time.

2,278.92 seconds of total stop time despite accessing zero delivery points - that is, despite doing nothing. If, indeed, the laws of econometrics compelled agreement with this view, then common sense would likewise compel agreement with Ms. Crowder that there must be something seriously wrong with the ES regression data set that it should produce an equation that implies such a nonsensical prediction of zero-volume stop time. Mr. Crowder's interpretation is, however, flatly contradicted by the correct analysis of the intercept term. In standard econometric analysis, the intercept in an equation defining time as a function of workload is correctly regarded as measuring the portion of that time that is fixed with respect to the workload amount (e.g. mail volume). Based on this accepted interpretation, the 2,278.92 seconds is an estimate of the portion of predicted total route-level stop time at given volumes that is fixed with respect to that volume and volume mix. Specially, the 2,278.92 seconds should not be perceived as a prediction that the carrier will spend 2,278.92 seconds doing nothing. Instead, it is a prediction that when the carrier does load at least 200 letter pieces on a route, 2,278.92 seconds out of the aggregate stop time this activity will generate will equal the fixed-time component of that aggregate time.[11]

This correct view of the weighted intercept value applies equally to the value Ms. Crowder estimates based on her own regression, which defines route-level load time as a function of the delivery mode of the route plus total possible deliveries by type. (Tr. 32/16196-202). In both the ES-based regression and the Crowder regression, the weighted intercept does not predict an amount of time spent doing nothing; it predicts

[11] Ms. Crowder also improperly interprets the fixed time predicted by the weighted intercept derived from her own regression as a nonsensical prediction of positive stop time generated when no delivery points are accessed. (Tr. 32/16204).

the fixed portion of time that is generated only when positive volumes are loaded. Thus, these large weighted intercepts do not prove that the regression data set contains excessively high load time values.

3.2 Using the ES-Based Load-Time Regression Analysis to Compute Variabilities Negates the Issue of Whether Certain Disputed Tallies are Load Time or Access Tallies

Despite her conclusion that the ES-based regression analysis has the alleged defect of predicting the existence of substantial stop time when no deliveries are accessed, Ms. Crowder nevertheless proffers a qualified endorsement of this analysis. Ms. Crowder recommends, specifically, that if the new ES-based street-time percentages for load time are used, over her strong objection, to estimate total accrued load time cost, the ES-based regression should replace the stop-level regressions as the source of the load-time volume variabilities. (Tr. 32/16150). Ms. Crowder justifies this qualified recommendation by arguing that that the ES-based regression analysis "is developed from the same dataset used to calculate city carrier street time proportions." She states further that the ES-based analysis is therefore "not subject to the distortions in volume-variable cost measurement that result when different data bases are used to measure accrued costs and volume variabilities." (Tr. 32/16214). In other words, the route-level load times in the ES-regression dataset are derived from the same tally percentages that produced the Postal Service's aggregate accrued load time cost estimate. The volume variabilities derived from the route-level regression of these load times on corresponding volumes and deliveries are clearly consistent with this accrued cost. These route-level variabilities, and not the SDR, MDR, and BAM variabilities derived from a 1985 dataset that is totally inconsistent with the new accrued cost measurement, should therefore be applied to this accrued cost to compute the appropriate volume-variable costs.

The Crowder rationale for applying the ES-based volume variabilities to the ES-based total accrued load time cost is especially significant because it implies a decisive result beyond Ms. Crowder's own qualified endorsement of those variabilities. This result can be demonstrated through a further evaluation of the accrued load-time cost derived from the load time tallies. Recall that these tallies, in conjunction with tallies derived from the ES tally dataset for the other street time activities, are used to estimate the Postal Service's proposed new measures of street-time proportions by route category for all the street activities.[12] The Postal Service's BY 1998 total accrued load time cost equals the sum of the products of the proportions estimated for load time multiplied by total accrued letter route street time costs in the six route-type categories.[13] Ms. Crowder contends that because these load time proportions are too high, the Postal Service's accrued load time cost derived in this manner is also too high.

However, the specific reason Ms. Crowder believes the load time proportions are too high is her claim that many load time tallies are really route/access FAT tallies. Thus, Ms. Crowder believes that the alleged excess of the BY 1998 accrued load time cost over true load time cost equals route/access FAT accrued cost. (Tr. 32/16186-88, and MPA-LR-7).

[12] Docket No. R2000-1, USPS-LR-I-159 uses the tallies in the USPS-LR-I-163 dataset to compute the street-time percentages that I presented in my R2000-1 direct testimony (USPS-T-12). USPS-LR-I-453 uses the slightly revised tally data set presented in USPS-LR-I-383 to compute correspondingly, slightly revised street-time percentages. These new street-time percentages are shown in Table 12, below.
[13] See USPS-LR-I-80, Cs06&7.xls, sheet 7.0.4.1.

I agree with Ms. Crowder that because the load times in the ES-based regression are derived from the same tallies that produce the Postal Service estimate of accrued load time cost, the variabilities derived from that regression are appropriately applied to that cost. Now, suppose I agree, arguendo, that Ms. Crowder also correctly defines this cost as equaling true load time cost plus some substantial accrued access cost. Then the clear implication is that the variabilities derived from the ES-regression are appropriately applied to a cost equal to true load time plus access cost. In other words, whatever the Postal Service measure of accrued load time cost might be, the ES-based regression variabilities are the correct variabilities to apply to that cost. The volume-variable costs that this application produces are valid and reliable measures of the volume-variable portions of the accrued cost. They are, specifically, valid measures of volume-variable costs whether the corresponding accrued cost is pure load time cost or load time cost plus a portion of access cost.

The significant conclusion to infer from this result is that it doesn't matter whether Ms. Crowder is correct in alleging that the Postal Service's total accrued load time cost includes access cost. Ms. Crowder herself recognizes that the variabilities derived from the ES-based regression that is consistent with that accrued cost are the correct variabilities to be used to derive the volume-variable portions of that cost. (Tr. 32/16211-14). Thus, the Postal Service's volume-variable load-time costs are correct in any event. They are the correct measures of the attributable portion of whatever one chooses to call the accrued cost – pure load time or load time plus access.

This result adds another reason to the list of justifications presented in my response to UPS/USPS-T12-16 (a)-(b) for substituting the new ES-based regression analysis for the SDR, MDR, and BAM stop level analysis to derive the load-time variabilities. In addition to its consistency with the accrued cost to which those variabilities are applied, the ES-based regression analysis presents numerous advantages relative to the stop-level regressions. The ES-based analysis produces operationally sensible marginal load times with respect to volumes, and a highly robust measure of coverage-related load time. The latter equals a marginal load time with respect to deliveries that is consistently within the 4 to 5 second range across the several versions of the ES-regression have estimated. Further, the ES-based analysis is derived from and thus incorporates into the variability estimation recent ES volume and deliveries data that account for the existing load time–volume relationship far more effectively than do the 1985 data that produce the stop-level regressions. Finally, because the ES-based analysis is tied so closely to the Postal Service's accrued load time cost, its prediction of total cost at mean mail volumes is far closer to this accrued cost than is the predicted cost derived from the stop-level regressions.

3.3 Choosing the Appropriate Route-Level Regression for Computing Final Load-Time Volume Variabilities

Two issues, however, remain to be resolved in order to apply the ES-based regression analysis to the computation of volume-variable costs. Which ES-based regression should be applied, and how show the deliveries variable in this regression be interpreted in order to compute the variabilities?

a. The USPS-LR-I-402 Table 3D – 4D Regression Produces the Most Accurate Variabilities

In my response to UPS/USPS-T12-16 (a) -(b), I recommend applying the regression summarized in tables 3B and 4B of that response. This regression adds the small parcels and rolls (SPR) variable to the parcels variable to create a single parcels term. This term is then included as an explanatory variable along with total letters, total flats, total accountables, dummy terms representing high load time per piece route days, and variables defining percentages of possible deliveries falling within the various delivery type categories. As I observe in the interrogatory response:

> The Table 3B and Table 4B regression results are...the most statistically reliable and operationally representative results ...computed to date. They preserve all of the positive features of the original Table 3 and Table 4 results presented in [USPS] LR-I-310. Furthermore, they include a high R-square, and an overall F value of 36.81, which is over 6 points higher than the comparable F value produced by the original Table 3 regression. The most critical improvement obtained by the new model, however, is the estimation of coefficients that imply a marginal load time for parcels at mean daily volumes equal to 26.13 seconds. This estimate is clearly more reasonable than the previous estimates of 126 seconds or higher produced by the Table 3 and Table 3A regressions.

However, in my response to UPS/USPS-T12-20(a) - (c), I estimate a new equation that is the same as the Table 3B equation except that it splits the single aggregate parcels variable into two separate variables, one for SPRs and the other for regular parcels. My interrogatory response summarizes this new regression in tables 3D and 4D, which are reproduced below.

TABLE 3D. New Quadratic Load-Time Equation Based On The 1996-1998 Engineered Standards Data Base (t-Statistics Are In Parentheses)

Independent Variable	Coefficient Estimated
Intercept	-4,885.84 (2.39)
Load Time/Letters Dummy	2,872.58 (8.94)
Load Time/Flats Dummy	1,904.85 (6.00)
Load Time/Accountables Dummy	2,238.04 (8.99)
Load Time/SPR Dummy	220.88 (0.86)
Load Time/Parcel Dummy	1,113.69 (3.84)
Letters Delivered	1.40 (2.45)
Letters Delivered Squared	-0.0004 (3.80)
Flats Delivered	0.47 (0.33)
Flats Delivered Squared	-0.001 (2.06)
Accountables Delivered	292.48 (3.87)
Accountables Delivered Squared	-7.17 (3.57)
SPRs Delivered	42.25 (2.02)
SPRs Delivered Squared	-0.21 (1.61)
Parcels Delivered	82.80 (2.43)
Parcels Delivered Squared	-0.72 (1.21)
Deliveries	-0.75 (0.25)
Deliveries Squared	0.0002 (0.065)
Letters*Deliveries	0.002 (2.74)
Flats*Deliveries	0.005 (2.89)
Accountables*Deliveries	-0.11 (1.12)
SPRs*Deliveries	-0.03 (0.80)
Parcels*Deliveries	-0.06 (1.15)
% of Deliveries That Are Residential Other	5,768.49 (3.16)
% of Deliveries That Are Residential Curb	8,657.60 (4.72)
% of Deliveries That Are Residential Central	7,518.82 (3.95))
% of Deliveries That Are Residential NDCBU	7,140.73 (3.74)
% of Deliveries That Are Business Other	4,260.11 (2.11)
% of Deliveries That Are Business Curb	2,091.71 (0.80)
% of Deliveries That Are Business Central	10,101.00 (3.37)
R-Square	56.64%
F Statistic	32.43
Number of Observations	750

TABLE 4D. New Total Load Time Per Route-Day, Marginal Load Times, And Load-Time Elasticities Derived From The New Load-Time Regression Dataset	
Predicted Daily Load Time	9,136.21 Seconds
Marginal Load Times (in seconds)	
Letters	1.08
Flats	1.40
Accountables	181.76
SPRs	22.48
Parcels	36.50
Deliveries	4.32
Estimated Elasticities	
Letters	22.43%
Flats	8.28%
Accountables	7.79%
SPRs	4.17%
Parcels	4.15%
Deliveries	23.34%

The new regression includes all of the positive features of the Table 3B - 4B regression results.[14] In addition, it produces two separate but plausible marginal load times and load time elasticities for SPRs and regular parcels, respectively. The marginal load times and elasticities equal 22.48 seconds and 4.17% for SPRs, and 36.5 seconds and 4.15% for regular parcels. These results are clearly sensible. SPRs can typically be loaded directly into mail receptacles, thereby requiring relatively little stop time, whereas many regular parcels are too large for direct loading, and therefore require delivery of the piece directly to the customer.

In addition to this plausible new outcome, the Table 3D and 4D results predict estimated total accrued load time cost at mean volumes equal to $3,288,673,000. This amount is even closer to the BY 1998 accrued load time cost estimate of $2,856,175,000 than is the cost predicted by the Table 3B and 4B regressions. These added positive features of the new regression, combined with the advantages of the

[14] USPS-LR-I-402 documents the data file and SAS program used to estimate the Table 3D regression.

earlier regression that the new regression preserves argue strongly in favor of using the new regression for deriving load time variabilities. These final variabilities, listed in Table 4D, should therefore be substituted for the current BY 1998 load-time variabilities to produce BY 1998 volume-variable load time costs.

b. The Deliveries Variable Accounts for the Effects of Changes in Actual Deliveries on Load Time

Ms. Crowder also agrees that the ES-based regression analysis provides the best tool for computing the load time volume variabilities, assuming that is, that the ES-based street time proportions are used to measure accrued load-time cost. However, her method of applying the ES regression to compute volume variabilities differs from my own approach in one important respect. Ms. Crowder and I agree that the cost computation should multiply total accrued cost by the Table 4D elasticities with respect to letters, flats, SPRs, regular parcels, and accountables to produce corresponding pools of volume-variable costs. However, Ms, Crowder rejects my view that the Table 4D elasticity of load time with respect to deliveries times the deliveries elasticity should be viewed as the appropriate route-level coverage-related load time elasticity. Ms. Crowder therefore rejects my view that this elasticity should also be multiplied by total accrued load time cost to produce volume variable coverage-related load time cost, and that this latter cost should be distributed in the same way that volume-variable access cost is distributed to mail subclasses. (Tr. 32/16191-93).

This dispute has arisen even though Ms. Crowder and I agree that in order to accurately quantify the impact of volume growth on the loading activity, the variability analysis must explicitly account for two distinct effects of volume growth on route-level load time. The first, or elemental load time effect, is the increase in load time at existing actual stops that occurs because the volume increase causes more pieces to be loaded at those stops. The second, or coverage-related effect, is the load time generated at new, previously uncovered stops that this volume increase converts into covered stops. Our dispute relates to how the regression should be applied in order to quantify this coverage-related effect. I view the sum of the elasticities of load time with respect to the five volume variables as quantifying only the elemental load time effect. This sum defines the elemental effect as the aggregate elasticity of load time at existing stops with respect to volume growth. A different measure is required to define the coverage-effect. By interpreting the deliveries variable as actual deliveries, I define this measure as the elasticity of route-level load time with respect to the deliveries variable times the elasticity of deliveries with respect to volume.

Ms. Crowder rejects my view that the sum of the elasticities of load time with respect to the five volume terms quantifies only the elemental effect, arguing instead that this sum, by itself, captures both elemental and coverage-related effects. Ms. Crowder adopts this position because she also denies that the deliveries variable can be regarded as actual deliveries. She argues that the deliveries variable can only be interpreted as a control term. According to this view, the only reason the deliveries variable is in the regression is to prevent the effects of variations in possible deliveries across routes from being erroneously attributed to the five volume terms. (Tr. 32/16191-93, 206).

In my view, the correct choice among these opposing views is the one most consistent with the ES-based load-time regressions. Specifically, the correct choice presents the most realistic explanation of why all of these regressions produce a marginal load time with respect to deliveries of between 4 and 5 seconds. Ms. Crowder's interpretation of the deliveries variable as a control variable implies a specific, but unreasonable interpretation of these marginal load times. According to this interpretation, "[t]he number of possible deliveries affects stop-level load time by affecting the number of actual deliveries, independently of volume." Thus, Ms. Crowder argues that "[leaving volume constant, an increase in possible deliveries increases the number of actual deliveries. This is because the volume-coverage function will distribute the constant level of volume among more actual deliveries when there are more possible deliveries." (Tr. 32/16192, fn. 45). Moreover, it is this increase in actual deliveries that causes the additional 4 to 5 seconds of load time, according to the Crowder approach.

To better illustrate what Ms. Crowder is saying here, consider two hypothetical routes, A and B. Suppose these routes have the exact same mail volumes, and that they differ only in that route A has 290 possible deliveries and route B has 293 possible deliveries. Ms. Crowder's position is that even through volume and volume mix are the same on both routes, route-level load time is higher on B because the greater number of possible deliveries on B translates into more actual deliveries, lower pieces per actual delivery, and hence higher load times per piece, due to the loss of variable scale economies. She further claims that the possible deliveries variables is needed to prevent this increase in load time from route A to route B, caused solely by the greater possible deliveries on route B, from being erroneously measured as a volume effect.

The problem with this operational analysis is that it cannot possibly justify the observed 4 to 5 second increase in load time generated by a new delivery. Specifically, it cannot explain how a one-delivery point increase can cause such a significant increase in load time. To see why, observe that Ms. Crowder identifies the increase in load time from route A to route B as an increase due solely to the spreading of volume over 293 possible deliveries on B as opposed to 290 possible deliveries on route A. Thus, average pieces per delivery and load time per piece over the first 290 of these route B possible deliveries **are exactly the same** as they are over the same 290 deliveries on route A. Only the three new deliveries on route B out of its 293 total - an extra amount accounting for only 1% of this total - cause total route level pieces per delivery to be lower on B than on A. The clear implication is that total route-B pieces per delivery can only fall below route-A pieces per delivery by a correspondingly small amount. Route B load time per piece must therefore **exceed** route A load time per piece by a comparably small amount. This excess is, in particular, much too small to cause an increase of 4 to 5 seconds per additional delivery on B, and an increase of 12 to 15 seconds over all three additional deliveries.

This operational implausibility of Ms. Crowder's analysis is further revealed through examination of another type of change that a valid interpretation of the route-level regression must be able to explain. Consider the case in which deliveries on just one route increase by one delivery point over a given time period. Note, again, that the ES-based route-level regressions predict that this increase will cause a 4 to 5 second increase in load time. According to Ms. Crowder's position, within the framework of the ES-based route-level regression, this additional delivery point must be regarded strictly as an additional possible delivery point. According to this position, the additional delivery cannot be regarded as an additional actual delivery. Thus, Ms. Crowder is forced by her methodology to conclude that the additional delivery causes 4 to 5 seconds of additional load time even though this delivery isn't even accessed! Such a nonsensical result is clearly the fatal flaw in the entire Crowder approach. It is ludicrous to propose, as Ms. Crowder's interpretation proposes, that the addition of a delivery point that the carrier does not delivery any mail to will nevertheless cause an increase of 4 to 5 seconds in loading time.

Obviously, the only sensible interpretation of the deliveries variable consistent with the estimated 4 to 5 seconds of marginal load time is that the additional delivery **is** accessed by the carrier. This logical imperative explains why I regard the delivery variable as a proxy for actual deliveries. Obviously, within the framework of the regression equation, this variable – although measured in terms of possible deliveries – functions as a proxy for the effect of changes in actual deliveries on load time.

Moreover, there is no reason this interpretation of the deliveries variable as a proxy for actual deliveries should be disconcerting to Ms. Crowder. In this role as a proxy, the deliveries variable still effectively performs the control function that Ms. Crowder justifiably regards as critical. Operating as a proxy, its presence in the regression does ensure that the effect on load time of an increase in deliveries will not be erroneously attributed to the volume terms. Furthermore, Ms. Crowder herself has specified and estimated a route-level regression that defines possible deliveries as a proxy for **both** actual deliveries and volumes. (Tr. 32/16189, fn. 43, and 16196, fn. 1) Given Ms. Crowder's willingness to interpret possible deliveries as a proxy for actual deliveries and volumes combined, she can hardly object to my decision to interpret possible deliveries as a proxy for just actual deliveries by itself.

Moreover, given the appropriateness of interpreting the deliveries variable as quantifying the effects of actual deliveries on load time, my application of the route-level regression to the calculation of volume-variable coverage-related load time is likewise correct. Specifically, I appropriately regard the marginal load time with respect to deliveries, and the corresponding elasticity of load time with respect to deliveries, as measurements of the additional load time caused by additional delivery coverage. I am further justified in regarding the product of this elasticity and the elasticity of actual deliveries with respect to volume as the correct, route-level variability of coverage-related load time with respect to volume.

Part 4. The Critique of the New Street-Time Percentages

4.1 Ms. Crowder Misinterprets Changes in Load Time Per Stop

As observed earlier, Ms. Crowder argues that the ES-based load time proportions of total street activity are much too high. One argument she presents to support this contention is that these load time proportions imply implausibly large increases in total load times over the past 12 years. (Tr. 32/16179-85). Ms. Crowder supports this argument by comparing total 1986 and 1998 load times per stop. This comparison is presented in the following table obtained from page 34 of her Docket No. R2000-1 Testimony. (Tr. 32/16179).

Table 5. Changes in Load Time Per Stop, FY 1986 – FY 1998

	1986 Load Time Per Actual Stop	1998 Load Time Per Actual Stop	Change
SDR	11.79 sec.	17.04 sec.	44.6%
MDR	75.56	114.35	51.3%
BAM	21.67	36.21	67.1%
Wtd. Avg.	17.37	26.01	49.7%

Ms. Crowder contends that the 1998 load times per stop, computed as the ratios of BY 1998 ES-tally based load times to actual stops are much too high relative to corresponding 1986 values, which equal the ratios of BY 1986 STS-based load times to actual stops. The increase from the 1986 to the 1998 load times per stop implies, according to Ms. Crowder, "that the proportion of route time (excluding street support) spent by carriers loading mail has increased from 30% to 50%." (Tr. 32/16180). Ms. Crowder then rejects witness Kingsley's explanations of why accrued load time has increased substantially over the past several years as being totally insufficient to justify increases of that magnitude, or to justify the corresponding decreases in CAT and FAT run time. Ms. Crowder concludes that "while there have been operational changes" over the past several years, the Postal Service's explanations cannot "account for the enormity of the increased load time implied by [witness] Raymond's [tally] data and analysis." (Tr. 32/16185).

I must reject these conclusions. Ms. Crowder's analysis incorrectly judges the magnitude of the increase in load times from 1986 to 1998 by evaluating changes in accrued time, instead of changes in volume-variable load time. For rate case cost analysis, volume-variable load times, not accrued times are the key street-time components that must be explained to ensure correct attribution of costs to products. The table below therefore restructures the Crowder table (Table 5) by substituting volume-variable load times per actual stop for Ms. Crowder's accrued times per stop. Moreover, the volume-variable load times that are the numerators of these volume-variable load times per stop ratios are calculated based on the unique volume variabilities applicable to each of the two time periods.

Table 6. Changes in Volume-Variable Load Time Per Stop, FY 1986 – FY 1998			
	1986 Volume-Variable Load Time Per Actual Stop	1998 Volume-Variable Load Time Per Actual Stop	Change
SDR	5.85 sec.	NA	NA
MDR	53.79	NA	NA
BAM	10.91	NA	NA
Wtd. Avg.	9.82	13.26	35.0%

For 1986, the applicable volume variabilities are derived from the SDR, MDR, and BAM regressions, since those regressions are derived from the 1985 LTV data set that accurately represents the 1986 operating environment. For 1998, the 1985 LTV data set is no longer appropriate. The database consisting of the ES tallies and mail volumes recorded in the 1996-1998 Delivery Redesign study is clearly the correct source for the variability analysis. Therefore, the ES-based Table 3D regression presented in USPS-LR-I-402 and my response to UPS/USPS-T12-20 (a)- (c), and estimated through application of this ES database is the correct source of variabilities for the calculation of 1998 volume-variable load times per stop.

Observe also that the LR-I-402 regression applies to all stops combined. Therefore, the variabilities derived from this regression cannot be separated into distinct variabilities for the SDR, MDR, and BAM stop types; nor can they be used to define separate volume-variable load times per stop by stop type. Therefore, these new variabilities are used to compute a single aggregate route-level variability that implies a corresponding single BY 1998 total annual volume-variable load time and load time per actual stop, as shown in Table 6.

This volume-variable load time per actual stop is only 35.0% higher than the corresponding 1986 ratio. This increase is much less than the 49.7% increase in accrued load time per stop that Ms. Crowder calculates in order to judge the reasonableness of the new ES-based load time proportions. This 35.0% increase also results from absolute increase of only about 3.4 seconds per stop between 1986 and 1998. In my view, the explanations summarized by Ms. Crowder for why load time has increased substantially since the late 1980s are more than sufficient to justify this 3.4-second per stop increase. The changes in load time per stop between 1986 and 1998 are therefore not so large as to be operationally implausible. They indicate increases in load time that are within the bounds of expectation given the significant operational changes that have occurred between 1986 and 1998, such as the introduction of DPS mail, the substitution of relatively higher load-time-per-stop motorized routes for foot routes, and increases in total volumes per stop.

4.2 Ms. Crowder's Claim that Location or Activity Codes for Certain Load Time Tallies are Inconsistent with the Loading Activity has a Minimal Impact on the Final Street-Time Percentages

In response to Docket No. R2000-1, NAA/MPA-T5-1, Ms. Crowder also challenges witness Raymond's assignments of certain tallies to the load-time category, arguing that the location or activity codes of these tallies are inconsistent with the loading activity. (Tr. 32/16211-13). I demonstrate, however, that the allocation of these contested tallies to the load time category does not significantly affect the final load-time percentages. I do so by first removing from the tally data set all the load-time tallies, summarized in Table 7, whose assignments are alleged by Ms. Crowder to be inconsistent with carrier loading.

Table 7. Tallies Assigned to Load Time that have Location or Activity Codes that Are Alleged to be Inconsistent with the Carrier Loading Activity		
Location Code	**Activity Code**	**Activity Detail**
Point of Delivery	Travel b/t Delivery	Any
Point of Delivery	Parcel of Parcels	Walk Flat or Walking
Point of Delivery	Accountable	Walk Flat or Walking
Point of Delivery	Walking	Any
Point of Delivery	No Access to Box	Any
Point of Delivery	Hardship	LLV
Point of Delivery	Finger @ Delivery	LLV (if delivery type is dismount)
Point of Delivery	Delivery/Collect	LLV (if delivery type is dismount)
Point of Delivery	Delivery/Collect	Walk Flat or Walking
On Route	Delivery/Collect	Walk Flat or Walking
On Route	Accountable	Walk Flat or Walking
On Route	Finger @ Delivery	Walk Flat or Walking
On Route	Parcel of Parcels	Walk Flat or Walking
On Route	Walking	Walk Flat or Walking
Vehicle	Finger @ Delivery	LLV (if delivery type is central)
Vehicle	Delivery/Collect	Any (if delivery type is Dismount or Park & Loop)

Next, I use the remaining tallies to recalculate the street-time percentages. USPS-LR-I-454 documents the SAS program that performs this computation. Table 8 presents these new street time percentages, and Table 9 shows the differences between these new percentages and the street time percentages calculated with the contested tallies included. Table 9 shows that the load time percentages remain constant or decrease by very small amounts within all six route-type categories. Thus, even if Ms. Crowder's allegation that these tallies are inappropriately assigned to load time is accepted, her point is still irrelevant. The removal of these tallies has no significant impact on the final calculations of the street time percentages.

Table 8. Street Time Percentages After Tallies Removed						
Street Activity	Residential Loop	Residential Curb	Mixed Loop	Mixed Curb	Business Motorized	Foot
Load Time	34.59%	47.33%	33.84%	35.31%	29.88%	48.86%
Street Support	18.05%	18.80%	13.23%	17.91%	17.38%	17.00%
Travel Time	4.92%	7.01%	3.98%	6.04%	3.05%	7.36%
Driving Time	11.29%	8.71%	18.97%	19.83%	27.13%	2.21%
Route/Access FAT	33.54%	9.51%	31.38%	20.76%	20.73%	31.11%
Route/Access CAT	2.24%	15.58%	2.34%	5.45%	4.88%	0.50%
Collection Box	0.29%	0.08%	0.23%	0.73%	0.00%	0.31%
Total	100%	100%	100%	100%	100%	100%

Table 9. Difference Between These Percentages and Percentages With Tallies Included						
Street Activity	Residential Loop	Residential Curb	Mixed Loop	Mixed Curb	Business Motorized	Foot
Load Time	-0.54%	-0.23%	0.000%	-0.08%	0.000%	-0.39%
Street Support	0.15%	0.08%	0.000%	0.02%	0.000%	0.13%
Travel Time	0.04%	0.03%	0.000%	0.01%	0.000%	0.06%
Driving Time	0.09%	0.04%	0.000%	0.02%	0.000%	0.02%
Route/Access FAT	0.28%	0.05%	0.000%	0.03%	0.000%	0.24%
Route/Access CAT	0.02%	0.04%	0.000%	0.01%	0.000%	0.00%
Collection Box	0.00%	0.00%	0.000%	0.00%	0.000%	0.00%

4.3 The Street-Time Percentages Should be Adjusted for Discrepancies Between the ES Sample and the Population in their Distributions of Delivery Points Across Delivery Types

Mr. Crowder also criticizes the USPS-LR-I-159 methodology that used the LR-I-163 ES tally dataset to estimate the new street time percentages. Ms. Crowder alleges that this methodology failed to account for key differences between the ES sample and the population of city carrier letter routes.

I believe Ms. Crowder's argument here is persuasive. Specifically, Ms. Crowder is correct in judging that the distribution of possible deliveries in the ES tally database across delivery-type categories is significantly different than the corresponding distribution in the population of all city carrier letter routes. (Tr. 32/16176-77). The specific differences also bias the new street-time percentages. One important difference is that the percentage of deliveries that are residential curb and residential centralized deliveries is significantly higher in the ES sample than in the population. In addition, the percentage of deliveries that are "residential other" is significantly lower in the sample than in the population. These discrepancies distort the street-time percentage estimates because load times per stop on route segments containing predominantly curb and centralized delivery points are generally higher than they are on route segments containing predominantly "residential other" delivery points, which are generally foot-accessed park & loop deliveries. Therefore, the failure of the LR-I-159 methodology to explicitly account for these discrepancies in its calculation of street-time proportions causes the load-time proportions, in particular, to be upwardly biased.

However, this problem does not, as Ms. Crowder contends, discredit witness Raymond's analysis. It does not establish that Mr. Raymond overallocated ES tallies to load time. Instead, it establishes only that the methodology employed to compute the new street-time proportions failed to calibrate those proportions for the differences between the sample and population distributions of delivery points by delivery type.

I therefore propose to adjust that methodology for the excessive percentage of residential curbline and residential centralized delivery points in the ES sample relative to the population, and the relative deficiency in the ES sample's percentage of "residential other" delivery points.[15] This new methodology first assigns deliveries to four groups: residential curb, residential centralized (the sum of residential central and residential NDCBU), residential other, and all business deliveries. The percentage of deliveries by group is then calculated for each of the six route types: foot, residential park & loop, residential curb, mixed loop, mixed curb, and business motorized. This calculation is made separately for population routes, and again for ES sample routes. The results are presented in Table 10.

[15] The term "residential centralized" in this analysis refers to the sum of residential central and residential NDCBU possible deliveries.

Table 10. Percentage Distribution of Deliveries in the Population and in the ES Sample				
Route Type	Residential Curb Deliveries	Residential Centralized Deliveries	Residential Other Deliveries	Total Business Deliveries
Residential Loop Population	7.85%	24.17%	61.74%	6.23%
Residential Loop ES Database	6.25%	33.28%	54.81%	5.66%
Residential Curb Population	48.87%	31.82%	13.80%	5.50%
Residential Curb ES Database	57.49%	22.46%	16.07%	3.99%
Mixed Loop Population	6.41%	19.28%	33.05%	41.25%
Mixed Loop ES Database	6.00%	12.03%	44.68%	37.30%
Mixed Curb Population	22.39%	22.23%	12.97%	42.41%
Mixed Curb ES Database	17.92%	27.20%	14.97%	39.91%
Business Motorized Population	2.63%	3.27%	4.13%	89.97%
Business Motorized ES Database	7.56%	5.54%	0.14%	86.77%
Foot Population	3.65%	40.73%	44.74%	10.88%
Foot ES Database	1.05%	55.64%	29.47%	13.84%

In order to correct the ES street-time proportions for the discrepancies between the sample and population distributions of deliveries shown in Table 10, the ES sample is first used to compute a separate set of street time percentages for each of the four delivery groups. These four sets of street-time percentages are presented in Table 11. USPS-LR-I-453 documents the SAS program that computes these percentages.

Table 11. Street-Time Percentages for Each of Four Delivery Groups				
Street Activity	Residential Curb Deliveries	Residential Centralized Deliveries	Residential Other Deliveries	Total Business Deliveries
Load Time	59.450%	66.507%	31.308%	32.915%
Street Support	4.996%	09.037%	10.998%	11.877%
Travel Time	3.925%	04.388%	02.953%	5.632%
Driving Time	0.00%	13.920	13.395%	21.163%
Route/Access FAT	0.00%	5.596%	39.849	24.204%
Route/Access CAT	29.795%	0.00%	0.00%	0.7053%
Collection Box	0.0607%	0.219%	0.1347%	0.6935%

The distributions of deliveries presented in Table 10, along with the street time percentages in Table 11, are then used to compute two sets of weighted-average street time percentages. The first set is based upon the distribution of deliveries in the population, and the second is based upon the distribution of deliveries in the ES sample. These two sets of street-time percentages are then compared to determine how much street time percentages in the ES sample should be adjusted to reflect the distribution of deliveries in the population.

USPS-LR-I-453 documents this computation of weighted-average street time percentages for each of the six route types. However, to illustrate the methodology, the computation performed just for the residential park & loop route type is presented here.

To calculate weighted-average street time percentages based upon the distribution of deliveries in the population, the Table 11 street-time percentages for each of the four delivery groups were multiplied by the respective residential park & loop percentages of deliveries, presented in Table 10. For example, to compute the weighted-average residential park & loop load-time percentage based upon the distribution of deliveries in the population, the following calculation was done:

59.450% * 7.85% + 66.507% * 24.17% + 31.308% * 61.74% + 32.915% * 6.23% = 42.13%.

Similarly, to compute the weighted-average residential park & loop load-time percentage based upon the distribution of deliveries in the ES sample, the following calculation was performed:

59.450% * 6.25% + 66.507% * 33.28% + 31.308% * 54.81% + 32.915% * 5.66% = 44.87%.

The load-time percentage based upon the population distribution of deliveries (0.4213) is equal to 93.88 percent of the load-time percentage based upon the ES distribution of deliveries (0.4487). This 93.88 percent is therefore used as an adjustment factor to correct the ES-based load-time percentage calculated for the residential park & loop route category to reflect the true distribution of deliveries in the population. Similar calculations were carried out for each street-time activity for each of the six route types, producing six sets of adjustment factors. USPS-LR-I-453 documents the calculation of all of these adjustment factors, as well as the application of these factors to the derivation of corrected ES-based street-time percentages for all combinations of route-type category and street-time activity category.

Table 12 below presents the set of ES-based street time percentages prior to any adjustment, while Table 13 presents the results of multiplying each of the ES street time percentages by its associated adjustment factor and then normalizing so that the street time percentages sum to 100%.[16] The Table 13 street-time percentages are superior to the original street-time percentages because they are adjusted to reflect the true distribution of deliveries in the population across the delivery types.

Table 12. Street Time Percentages Prior to Adjustment

Street Activity	Residential Loop	Residential Curb	Mixed Loop	Mixed Curb	Business Motorized	Foot
Load Time	35.14%	47.56%	33.84%	35.39%	29.88%	49.25%
Street Support	17.90%	18.71%	13.23%	17.89%	17.38%	16.87%
Travel Time	4.88%	6.98%	3.98%	6.03%	3.05%	7.30%
Driving Time	11.20%	8.66%	18.97%	19.81%	27.13%	2.20%
Route/Access FAT	33.26%	9.47%	31.38%	20.74%	20.73%	30.88%
Route/Access CAT	2.22%	15.54%	2.34%	5.44%	4.88%	0.50%
Collection Box	0.29%	0.08%	0.23%	0.73%	0.00%	0.31%
Total	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%

[16] The pre-adjustment street-time percentages presented in Table 12 are slightly different than the USPS-LR-I-159 percentages presented in my direct testimony (USPS-T-12). The reason is that theTable 12 percentages are derived from the slightly revised ES tally data set documented in USPS-LR-I-383. USPS-LR-I-453 computes these Table 12 pre-adjustment percentages, as well as the adjustment factors, and it uses these factors to produce the adjusted percentages shown in Table 13.

Table 13. Street-Time Percentages after Adjustment to Reflect the Distribution of Deliveries in the Population						
Street Activity	Residential Loop	Residential Curb	Mixed Loop	Mixed Curb	Business Motorized	Foot
Load Time	32.50%	47.93%	36.54%	35.12%	28.25%	43.13%
Street Support	17.75%	19.05%	13.38%	17.92%	17.83%	16.17%
Travel Time	4.67%	7.09%	4.21%	6.09%	3.06%	6.56%
Driving Time	10.85%	10.45%	19.46%	19.25%	28.51%	2.02%
Route/Access FAT	35.90%	9.37%	27.84%	20.21%	22.99%	37.06%
Route/Access CAT	2.74%	13.11%	2.53%	6.76%	2.42%	1.35%
Collection Box	0.27%	0.09%	0.25%	0.74%	0.00%	0.26%
Total	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%

Part 5. The Volume Variability of Loop/Dismount Costs Should be Set Equal to Zero

This part of my testimony analyses the portion of driving time cost that is caused by carriers driving their vehicles to stopping points in order to access park & loop and dismount delivery points on foot. I evaluate witness Mike Nelson's proposed new method for measuring the volume-variable portion of this cost. I reject the Nelson proposal, but I also recommend my own new methodology to replace the established approach.

Witness Michael Nelson's Docket No. R97-1 analysis (USPS-T-19) derived a volume variability of 40.99% that is applied in the BY 1998 cost analysis to accrued loop/dismount vehicle access cost. Mr. Nelson summarizes the methodology he applied to derive this variability in the following excerpt from his Docket No. R2000-1 testimony.

> Basically, routine loops that are established on the basis of volume/weight were treated as 100% volume variable because of the constraints on the formation of such loops imposed by the 35-lb. weight limit on carrier satchel loads. Routine loops and dismounts established for reasons other than the volume/weight of mail were treated as 0% volume variable, as the number of such stops would remain fixed as volume changes. The proper treatment for the remaining stops - dismounts established on the basis of mail volume/weight -was somewhat ambiguous.
>
> On the one hand, existing dismounts made because of volume/weight will remain fixed if volume increases. On the other hand, volume increases likely will

> cause new dismounts to be made because of volume/weight. In the absence of any other information, this group of dismounts was ascribed the cumulative variability of the other 3, leading to the overall estimated variability of 0.4099.

(Tr. 28/13415).

The following table shows how this assignment of the 0.4099 variability that Mr. Nelson derived for the first three loop/dismount cost components to the cost of dismounts due to volume/weight produces 0.4099 as the total loop/dismount variability.

Table 14. Calculation of the Volume Variability of Loop/Dismount Driving Time Costs

Stop Type	Total Stops	% of Stops	Volume Variability
Loops Due to Volume/ Weight	242,294,460	0.3215	1.0000
Loops Due to Other Factors	85,273,149	0.1131	0
Dismounts Due to Other Factors	263,516,968	0.3496	0
Dismounts Due to Volume/ Weight	162,610,282	0.2158	0.4099[17]
Total	753,694,859	1.0000	0.4099

However, Mr. Nelson's Docket No. R2000-1 testimony also recommends a modification to this calculation. Mr. Nelson now argues that "there is an interaction between volume-driven looping points and volume-driven dismounts that was not accounted for in the R97-1 analysis." (Tr. 28/13415). He claims first that "stops that

[17] Calculated as (242,294,460/(242,294,460 + 85,273,149 + 263,516,968)).

would become new volume-driven dismounts in the presence of a volume increase are currently served on loops." (Tr. 28/13415-16). He also notes the previous analysis' assumption "that a volume increase on volume-driven loops is accommodated entirely by an equal percentage increase in the number of loop parking points." He concludes, therefore, that this increase in loop stopping points caused by volume growth is sufficient to ensure that no new dismount stopping points are created in response to that volume growth. Finally, the 100% variability assumed for volume-driven loops indicates, in Mr. Nelson's view, that "volume-driven dismounts" should be viewed "as fixed (i.e., 0% variable)" with respect to volume. (Tr. 28/13416).

Mr. Nelson presents the following table to show how this new 0% variability for volume-driven as well as non-volume driven dismount stops produces a new overall variability of 0.3215. (Tr. 28/13416).

Table 15. Witness Nelson's Proposed Revised Calculation of the Volume Variability of Loop/Dismount Driving Time Costs

Stop Type	Total Stops	% of Stops	Volume Variability
Loops Due to Volume/ Weight	242,294,460	0.3215	1.0000
Loops Due to Other Factors	85,273,149	0.1131	0
Dismounts Due to Other Factors	263,516,968	0.3496	0
Dismounts Due to Volume/ Weight	162,610,282	0.2158	0
Total	753,694,859	1.0000	0.3215

My proposed approach to analyzing loop/dismount costs begins with a rejection of this Nelson analysis. First, Mr. Nelson provides no basis for his conclusion that "stops that would become new volume-driven dismounts in the presence of a volume increase are currently served on loops." Indeed, there is no reason to believe that these new dismount stops would not be found on non-loop route segments as well as on loop segments. Further, there is no basis for his conclusion that all new stopping points that are created due to volume growth must be loop stopping points instead of dismount stopping points. Finally, Mr. Nelson's conclusion that the volume variability of "volume-driven dismounts" should be regarded as 0% is blatantly contradictory. If "volume-driven" dismounts are, indeed, volume driven, then the variability of these dismounts must be greater than 0%.

One useful contribution Mr. Nelson does make, however, in reviewing the loop/dismount variability is his recognition that that the 35-lb. weight limit on carrier satchel loads is a key factor in the variability measurement. The reason is that a volume increase on a loop route segment will require the addition of a new vehicle stopping point if it causes the weight of the carrier's satchel to exceed 35 lb. The implication is that the variability of loop stopping points with respect to volume is clearly a function of the probability that a marginal increase in mail volume on a route will increase the satchel weight from some amount below this threshold to an amount exceeding the threshold.

This result is critical because a new dataset can now be used to directly calculate this probability of exceeding the 35-lb. threshold. This new dataset, presented and documented in USPS-LR-I-329, consists of 1,270 records reporting measurements of satchel weights taken during the ES Study. Each record lists the weight of one mail satchel that a data collector weighed at a given loop parking point prior to the time when the carrier began walking the loop to deliver mail. These 1,270 records consist of 1,270 separate weights measured at loop stops located on 76 separate routes. The measurements were also taken over a period of 139 route-days.

The key statistics derived from these data are that the average satchel weight equaled only 11.33 pounds, well under the 35-lb. threshold. Moreover, only 2 of the 1,270 measurements exceeded 30 lb. One was 34 lb., and the other 42 lb.

These numbers establish that, for all practical purposes, there is a zero probability that a marginal (say one percent) increase in volume delivered across all the loops on the 76 routes where these measurements were taken would increase the weight of mail to an extent that a new loop parking point would be required. The clear implication is that the variability of loop stopping points with respect to mail volume is likewise zero.

The LR-I-329 dataset does not, however, provide any corresponding data regarding the variability of dismount stopping points. Satchels are only carried on walking loops, not on dismount deliveries. Thus, the finding that because existing satchel weights are so low, marginal volume increases will not push these weights over the 35-lb. threshold, implying a zero percent variability, is not directly relevant to dismount stops.

However, given the absence of any data to the contrary, it would appear logical that the volume variability of dismount stops is also zero. I have been informed by Postal Service operations analysts that routes are generally planned so that virtually all dismount stops have excess capacity. At some dismount stops, the carrier delivers the mail by hand, using no containers. At other dismount stops, the carrier carries the mail in tubs or other containers. In those relatively rare instances in which an increase in mail volume and weight will require a change in operations, the carrier's response will be to start using a satchel to carry the greater amount of mail, or, in some cases, to start using a dolly to carry a container or to even add additional containers that are stacked onto the dolly. The carrier almost never responds to a volume and weight increase at a dismount stop by adding a new vehicle stopping point.

Therefore, the inference drawn from the USPS-LR-I-329 data set that there is virtually no chance a marginal volume increase will require the creation of a new loop stop would apply equally to dismount stops. Indeed, the most likely response to a marginal increase in volume and weight at a dismount stop would be that the carrier would begin using a satchel to carry the mail. In other words, to the extent the carrier does anything at all differently due to the volume and weight increase, he is most likely to convert the stop into a loop stop. The total number of stopping points will, in this case, remain constant, confirming that the true variability for all stopping points, dismount as well as loop, is effectively zero.

Attachment A

The Mathematical Derivation of Coverage-Related Load Time

Ms. Crowder's initial new mathematical representation of route-level load time is the following linear equation:

$L = u * V + f * AS(V,PS)$ (1)

where u is a constant marginal load time with respect to route-level mail volume, V, f is fixed stop time at one stop, and AS is total route-level actual stops. Thus, u = $\partial L / \partial V$, and f = $\partial L / \partial AS$, and they are both constants. In particular, they are constant coefficients of the variables V and AS, respectively, and their constancy establishes the equation as being linear in V and AS.

Ms. Crowder modifies this linear equation in her response to USPS/MPA-T5-2(b) part (3). She changes u in equation (1) from a constant marginal load time per piece to a variable marginal load time that changes, specifically, in response to changes in both V and AS. This new equation is:

$L(V,PS) = V^* u \; [V, AS(V,PS)] + f * AS\,(V,PS)$ (2),

which now defines route-level load time as a nonlinear function of volume, as indicated by the fact that u now changes in response to changes in V and AS.

The critical implication of Ms Crowder's equation (1), and of the modification of that equation to produce equation (2) is that they establish that volume-variable coverage-related load time will equal the product of the stops elasticity, $(\partial AS / \partial V) * (V / AS)$, and the residual of accrued load time, L, over elemental load time, $L^*(\partial L / \partial V) * (V / L)$, if, but only if load time is a linear function of volume. Thus, the equations also show that the residual measure of coverage-related load time is incorrect if the load time equation is nonlinear.

To see why this is the case, observe that Ms, Crowder's equation (1) establishes that a linear load time function does produce the residual of accrued over elemental load time as the correct measure of coverage-related load time. This can be shown through substitution of u = $\partial L / \partial V$ into equation (1), to produce

$$L = (\partial L / \partial V) * V + f * AS(V,PS) \qquad (1a),$$

and through differentiation of (1a) to produce the following definition of the elasticity of load time with respect to volume ($\partial L / \partial V * (V / L)$):

$$(\partial L / \partial V) * (V / L) = (\partial L / \partial V) * (V / L) + f * (\partial AS / \partial V) * (V / L) \qquad (1b)$$

Multiplication of the second term on the right-hand side of (1b) by AS/AS produces

$$(\partial L / \partial V) * (V / L) = (\partial L / \partial V) * (V / L) + f * (\partial AS / \partial V) * (V / AS) * (AS / L)$$

or

$$(\partial L / \partial V) * (V / L) = E_e + f * (AS / L) * E_S \qquad (1c),$$

where $E_e = (\partial L / \partial V) * (V / L)$ is the elemental load time elasticity and $E_s = (\partial AS / \partial V) * (V / AS)$ is the stops elasticity, which is the elasticity of actual stops with respect to volume.

Finally, substitution of $f * AS = L - u * V = L - (\partial L / \partial V) * V$ (from equation 1) into 1c, and multiplication of both sides of equation 1c by L produces:

$$(\partial L / \partial V) * (V / L) * L = E_e * L + [1 - (\partial L / \partial V) * (V / L)] * E_S * L$$

or

$$(\partial L / \partial V) * (V / L) * L = E_e * L + (L - E_e * L) * E_S \qquad (1d)$$

Observe that $(\partial L / \partial V) * (V / L) * L$, the left-hand side of equation (1d), is total volume-variable load time. On the right-hand side, $E_e * L$ is elemental load time, $(L - E_e * L)$ is the residual measure of accrued coverage-related load time, and $(L - E_e * L) * E_S$ is the residual measure of volume-variable coverage-related load time. Thus, equation 1d defines total volume-variable load time as elemental load time plus the product of the residual measure of accrued coverage-related load time and the stops elasticity, E_S. Moreover, equation 1d is derived from the linear load time equation 1. Thus, it verifies that the linear load time equation does produce the residual of accrued load time over elemental load time multiplied by the stops elasticity as the correct volume-variable coverage-related load time.

Ms. Crowder's analysis of equation (2) shows what happens when route-level load time is a nonlinear function of volume. Equation (2), repeated below, is nonlinear because u now changes in response to changes in V and AS.

L(V,PS) = V* u [V, AS(V,PS)] + f * AS (V,PS) (2),

To derive expressions for elemental and coverage-related load time from equation (2), Ms. Crowder also defines u in equation (2) as total variable route-level load time per piece.

Differentiation of the nonlinear equation (2) with respect to actual stops (AS) produces the following expression for accrued coverage-related load time per stop.

$\partial L / \partial AS = f + V * (\partial u / \partial AS)$ (2a)

Multiplication of both sides of (2a) by AS produces the corresponding accrued route-level coverage-related load time:

$$(\partial L / \partial AS) * AS = f * AS + [V * AS * (\partial u / \partial AS)] \quad (2b)$$

Multiplication of this accrued coverage-related load time by the stops elasticity produces the following expression for volume-variable route-level coverage-related load time:

$$(\partial L / \partial AS) * AS * (\partial AS / \partial V) * (V / AS) = (f * AS + [V * AS * (\partial u / \partial AS)]) * (\partial AS / \partial V) * (V / AS),$$

or

$$(\partial L / \partial AS) * AS * E_s = (f * V + [V * (\partial u / \partial AS) * V]) * (\partial AS / \partial V)) \quad (2c).$$

Equation (2a) defines accrued coverage-related load time per stop as fixed stop time, f, plus the product of the marginal increase in unit variable load time, u, with respect to actual stops, AS, and total route-level volume, V. Thus, equation (2a) defines accrued coverage-related load time per stop as f plus the increase in total variable route-level load time that occurs because variable load time scale economies are lost when a mail piece goes to a new stop, instead of to an existing stop, causing u to increase. Equation (2b) defines total accrued route-level coverage-related load time as the sum of fixed stop time over all stops on the route, f * AS, and the product of the marginal increase in total variable load time with respect to actual stops, $V * (\partial u / \partial AS)$, and total actual stops. AS.

This equation (2b) definition of accrued route-level coverage-related load time derived from the more appropriate nonlinear load time equation (2) also differs from and thus invalidates the corresponding residual measure. The residual measure of route-level accrued coverage related load time, as derived from equation (2) is, by definition:

$$L - E_e L = f * AS + V * u - [(u + V * \partial u / \partial V) * V / L] * L = f * AS - V^2 * (\partial u / \partial V) \quad (2d),$$

where $E_e * L = [(u + V * \partial u / \partial V) * V / L] * L$ is route-level elemental load time.[18] This residual measure, $f * AS - V^2 * (\partial u / \partial V)$, is clearly different than the correct definition of accrued route-level coverage-related load time, $f * AS + [V * AS * (\partial u / \partial AS)]$. The specific difference between the two measures is Residual – Correct Measure = $V^2 * (\partial u / \partial V) - V * AS * (\partial u / \partial AS)$. Further, it can be expected that this difference really equates to a large excess of the residual over the correct measure, since on virtually all city routes, V^2 substantially exceeds V * AS, given that average pieces per stop are well in excess of one piece. Thus, not only does the residual deviate from the correct measure of accrued route-level coverage-related load time, but the magnitude of the deviation can be expected to be large, establishing the residual as a clearly inappropriate measure of coverage-related load time.

[18] Note that variable load time scale economies causes $\partial u / \partial V$ to be negative, and hence $- V^2 * (\partial u / \partial V)$ to be positive.